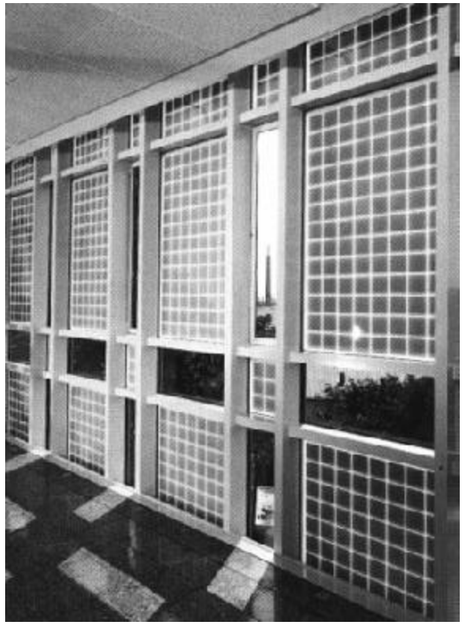
PHOTOVOLTAICS

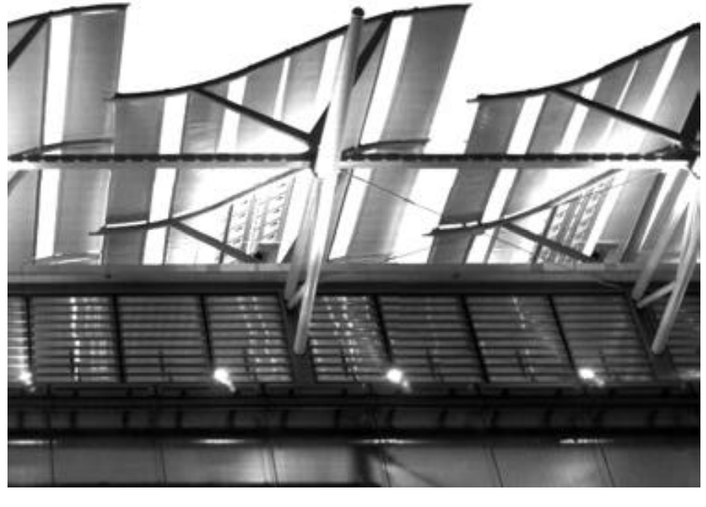
5. Georgetown University Intercultural Center
Washington, D.C., 1984

Photovoltaics are a power converter that produces electricity directly from sunlight. They are a composite made of pure silicon and were first used in the space industry to power space craft. Today they enjoy a wide array of uses on Earth, from powering buildings and automobiles to hand held calculators and water pumps. They exhibit the following characteristics:

Relatively low maintenance
No moving parts
Extremely long life
Modular design
Except for batteries, produce safe, low voltage
Non corrosive
Very durable when sandwiched between glass
Produce electricity from diffuse light



6. Window integrated photovoltaic array



7. British Pavilion, Seville, Spain
Nicolas Grimshaw & Partners, 1992

8. Kindergarten, Frankfurt, Germany
Funk & Schroder, Architects, 1990

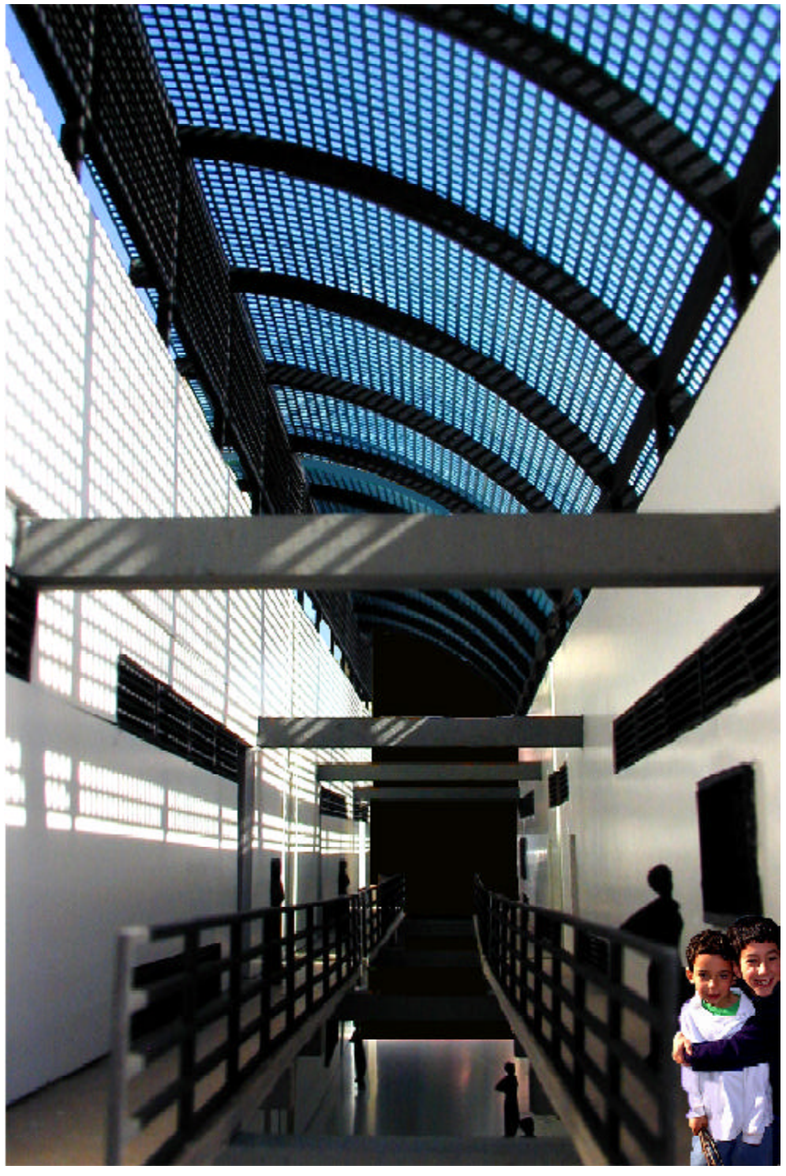
Silicon for photovotaics is produced in three formats: single crystal, multicrystaline, and amorphous. The crystaline type is very brittle, whereas the amorphous is flexible. Their colors range from deep blue to grey to rust, and in crystaline form are transluscent. The amorphous type can be used as roofing shingles, the glass integrated crystaline type as fenestration or skylights, or roof or wall mounted in aluminum frames.

In the Sun School, photovoltaic modules in aluminum frames form the atrium skylight, and are mounted at the roof and deck lines to form an electricity producing edge. In the Sun School all modules face south. For maximum efficiency, modules should be normal to the sun. For a stationary array this is not possible. For the maximum annual efficiency, then, the ideal tilt angle is equal to the latitude of the array's location. For Blacksburg this is 38 degrees above the horizontal. The average tilt angle of the atrium roof, however, is 30 degrees, since the sloped, curved roof is also used to enhance natural ventilation. An angle above this would, in my judgement, create an obstacle to the summer southwesterly breezes.

An electrical grid comprises the power lines and generating stations that produce electricity. Some photovoltaic buildings are connected to the electrical grid and some are not, choosing instead to store their electrical power in batteries. Some buildings are a combination of both. The Sun School is designed to be connected to the grid, with a small bank of batteries to be used as an educational tool to demonstrate that the photovoltaic electrical power can be stored in batteries. These batteries, for instance, can power the pond well-pump to demonstrate that the well can operate at night. During the day the well-pump can be powered directly by sunlight or diffuse light.

The Sun School has approximately 10,700 square feet of polycrystaline photovoltaic modules, which annually produce 732,943 kilowatt hours of electricity. This is approximately 25% of the school's requirements.

The photovoltaic system can demonstrate to students that a building's skin can produce electrical power while minimizing dependence on fossil fuels and their consequential air pollution, oil spills, and land destruction from strip mining. The Sun School can be a model for the town of Blacksburg and surrounding communities.



Atrium, January 28, noon

The photovoltaic atrium roof produces electricity, provides weather protection, and also modulates direct sunlight and diffused natural light. This modulation can be controlled according to the density of the solar cells.

The photovoltaic modules mounted on the first and second floor roofs, as well as the atrium roof, are accessible for examination, touching and studying.

Electrical production from the Sun Schools photovoltaic modules is a function of the modules' latitude, the season, time of day, weather, and dirt accumulation on the modules. Each of these functions can be metered and charted, and thus can be used as an educational tool demonstrating the direct correlation between sun exposure and electrical production. What is the amount of insolation (measure of the sun's energy striking the earth) on December 21 as compared to June 21? As compared to September 21 and March 21? What is the amount of insolation at 7 a.m., noon, and 6 p.m.?

The electrical load of the school building can be charted as a function of the time of day, season (summer break vs school in session). Electrical production from photovoltaics can be compared to the electrical load of the building, showing if there is any time at which the building is producing more electricity than it is consuming.

According to Virginia law, an electrical utility company is required to buy back, at a rate equal to the comsumer price, any excess electricity a building produces. This is termed "net metering". Thus an increase in electrical consumption of the school in the winter can be offset by an increase in electrical production in the summer. This is of great benefit to the school system and to the utility company. It helps to reduce the load on the utility company during the peak summer season, and thus reduces the likelihood of blackouts and brownouts.

Sectional model (1/4" =1') through pond, boat float, first and second floor decks, and atrium roof